The Influence of Cutting Condition on Surface Roughness in Face Milling Of Mild Steel

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ABSTRACT

This study is aimed to determine the influence of cutting conditions such as cutting speed, feed rate and depth of cut on surface roughness in face milling of mild steel. Perthometer is being used to determine the surface roughness. Several experiments have been carried out under various cutting conditions. Roughness result shows that the surface is smoother as the cutting speed increases until it reaches the optimum speed. On the other hand cutting speed that is beyond the optimum value results in more vibration, thus generating rough surface. Meanwhile increasing the feed rate shows higher surface roughness. The depth of cut, by increasing the surface, is smoother. So the optimal value of cutting condition must be used to minimize surface roughness.

Keywords: Surface roughness; Cutting parameters, face milling

INTRODUCTION

Face milling is the second most common method (after turning) for metal cutting and replacing the grinding as the finishing of machined parts. The reason is because this machining process has its flexibility, cheaper and simple machining range. The surface finish of machined parts is known to have a considerable effect on some properties such as wear resistance and fatigue strength. It is very important to ascertain the influence of different factors in the cutting process.

In the real world of manufacturing environment, machining process leaves its impact on the machined surface in the form of fine space irregularities. Each cutting tools leaves a pattern of its own on the material surface. The pattern is known as surface roughness. The machining process used can be known by close investigation of the surface. Surface irregularities are linked with the efficiency of the machining operation. Thus, the quality of the surface important for evaluating the productivity of machine tools, and mechanical parts. A proper cutting condition is extremely important because it helps to determine surface quality of manufactured parts [1].

FACE MILLING

Face milling is used to produce a flat surface parallel to the column of the machine. This is done by means of a face milling cutter mounted in the milling machine spindle. Face milling may also be done using a vertical milling attachment to produce horizontal flat surfaces. Both the periphery and the end of the teeth do the cutting [2]. Figure 1 shows a schematic of the face-milling process along with the various process parameters and cutter angles.

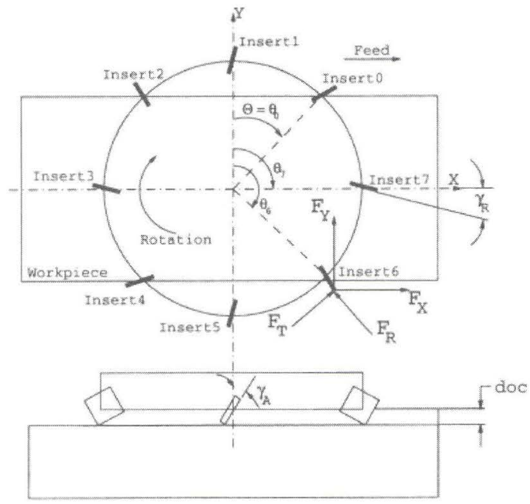

Figure 1: Face Milling Process Geometry [3]

CUTTING PARAMETERS

Cutting speed

The cutting speed for milling cutter is the speed, either in feed per tooth or in meter per minute that the periphery of the cutter should travel when machining a certain metal. The speeds used for milling cutter are much the same as those used for any cutting tool. Several factors must be considered when determining the proper revolutions per minute at which to machine a metal. The most important are type of work material, cutter material, diameter of the cutter, surface finish required, depth of cut being taken and rigidity of the machine and work setup. The cutting speed, V in milling is peripheral speed of the cutter. The cutting speed is being calculated as given below:

$$V = \pi DN \tag{1}$$

In the above equation, D is the cutter diameter and N is rotational speed of the cutter.

Feed rate

Feed rate is the work moves into revolving cutter; it is measured in either inches per minute or millimeters per minute. The feed rate on a milling machine depends on a variety of factors such as the depth and width of cut, design or type of the cutter, sharpness of the cutter, workpieces material, strength and uniformity of the workpiece, type of finish and accuracy required and power and rigidity of the machine. Feed per tooth is the amount of material which should be removed by each tooth of the cutter as it revolves and advances into the work. Feed per tooth can be determined from the equation below:

$$f = \frac{v}{Nn} \tag{2}$$

Where v is the linear speed of the workpieces and n is the number of teeth on the cutter periphery.

Depth of cut

Where a smooth accurate finish is desired, it is considered good milling practice to take a roughing and finishing cut. Roughing cuts should be deep, with a feed as heavy as the work and the machine will permit. Finishing cuts should be light, with a finer feed than is used for roughing cuts. Lighter cuts and extremely fine feeds are not advisable, since the chip taken by each tooth will be thin and the cutter will often rub the surface of the work, rather